PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
FP2662		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 00282	02/02/2000	02/02/1999
Applicant		
THE UNIVERSITY OF NEWCASTLE et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
GB 00/00282

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E02D3/11 B09C1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E02D B09C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 074 986 A (PROBSTEIN RONALD F ET AL) 24 December 1991 (1991-12-24) the whole document	1-7,10, 12, 17-21, 23,25, 26,28-30
A	US 5 476 992 A (HO SA V ET AL) 19 December 1995 (1995-12-19) column 4, line 54 -column 20, line 43; figures 1,2	1-7,10, 12,13, 17-21, 23-26,30
A	EP 0 504 551 A (PROCUREMENT & PROJECTS GMBH ;UWA UMWELTANALYTIK GMBH (DE)) 23 September 1992 (1992-09-23) the whole document	1-30

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 2000	18/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Tellefsen, J

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
[redacted]GB 00/00282

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 676 819 A (BRADY PATRICK V ET AL) 14 October 1997 (1997-10-14) the whole document	1-30
Y	EP 0 870 875 A (RASWILL REPRESENTATIVE PTE LTD) 14 October 1998 (1998-10-14) the whole document	1-7,10, 12, 17-21, 23,25, 26,28-30
A	GB 2 301 311 A (UNIV NEWCASTLE) 4 December 1996 (1996-12-04) cited in the application	
A	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 04, 31 May 1995 (1995-05-31) & JP 07 018654 A (SHIMIZU CORP;OTHERS: 03), 20 January 1995 (1995-01-20) abstract	
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 09, 31 July 1998 (1998-07-31) & JP 10 110426 A (OHBAYASHI CORP;TOAGOSEI CO LTD), 28 April 1998 (1998-04-28) abstract	
A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 570 (M-1060), 18 December 1990 (1990-12-18) & JP 02 243816 A (OHBAYASHI CORP), 27 September 1990 (1990-09-27) abstract	

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
GB 00/00282

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 5074986	A	24-12-1991	NONE			
US 5476992	A	19-12-1995	AT	173963	T	15-12-1998
			AU	696030	B	27-08-1998
			AU	7395594	A	24-01-1995
			CA	2162385	A,C	12-01-1995
			CN	1126450	A	10-07-1996
			DE	69415016	D	14-01-1999
			DE	69415016	T	24-06-1999
			EP	0706427	A	17-04-1996
			ES	2087049	T	16-07-1996
			GR	3029540	T	30-06-1999
			JP	8511990	T	17-12-1996
			NZ	269633	A	29-01-1997
			PL	312275	A	15-04-1996
			WO	9501232	A	12-01-1995
EP 0504551	A	23-09-1992	DE	4112893	A	13-08-1992
US 5676819	A	14-10-1997	NONE			
EP 0870875	A	14-10-1998	JP	11071746	A	16-03-1999
GB 2301311	A	04-12-1996	AU	1585595	A	29-08-1995
			JP	10500183	T	06-01-1998
			US	5980155	A	09-11-1999
			WO	9521965	A	17-08-1995
JP 07018654	A	20-01-1995	NONE			
JP 10110426	A	28-04-1998	NONE			
JP 02243816	A	27-09-1990	NONE			

EUROPEAN PATENT OFFICE

Patent Abstracts of Japan

PUBLICATION NUMBER : 07018654
PUBLICATION DATE : 20-01-95

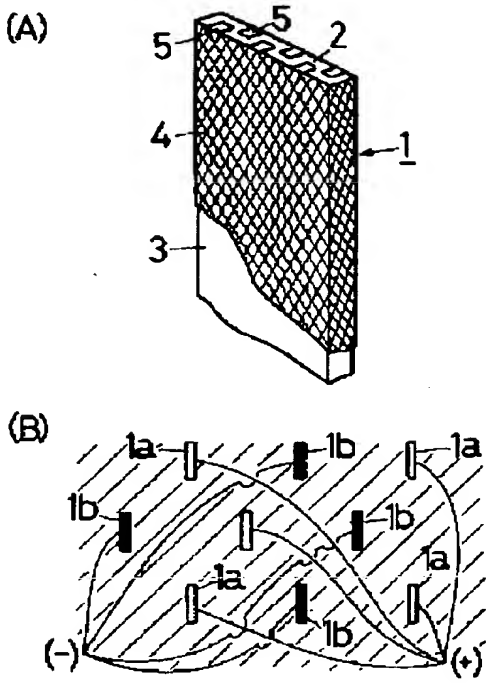
APPLICATION DATE : 09-03-93
APPLICATION NUMBER : 05047699

APPLICANT : KUROSAWA TEKKO KK;

INVENTOR : KUROSAWA MASAYUKI;

INT.CL. : E02D 3/11

TITLE : ELECTRIC DRAIN CONSTRUCTION METHOD



ABSTRACT : PURPOSE: To easily over-consolidate the ground, shorten the construction period, and reduce the cost.

CONSTITUTION: A lengthy plate-like drain member 1 constituted of a filter member 3 formed with water paths 5 inside and a metal net member 4 provided on the surface of the filter member 3 is used in this drain construction method, and a plurality of the drain members 1 are placed in the ground at an interval. A group of the drain members 1 are connected to a plus power source, and the other group of the drain members 1 are connected to a minus power source.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* FP2662

Box No. I TITLE OF INVENTION

METHOD FOR CONDITIONING A SUBSTRATE USING AN EKG

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

THE UNIVERSITY OF NEWCASTLE
6 KENSINGTON TERRACE
JESMOND
NEWCASTLE UPON TYNE

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

JONES, COLIN JOHN FRANCIS PHILIP
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF NEWCASTLE
NEWCASTLE UPON TYNE
NE1 7RU

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: GB

State *(that is, country)* of residence: GB

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

MARKGRAAF PATENTS LIMITED
THE CRESCENT
54 BLOSSOM STREET
YORK
YO24 1AP

Telephone No. 01904 610586

Facsimile No. 01904 610909

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☒ AP **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **TZ** United Republic of Tanzania, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ EA **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ EP **European Patent:** **AT** Austria, **BE** Belgium, **CH** and **LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ OA **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ AE United Arab Emirates
☒ AL Albania .....
☒ AM Armenia .....
☒ AT Austria .....
☒ AU Australia .....
☒ AZ Azerbaijan
☒ BA Bosnia and Herzegovina .....
☒ BB Barbados
☒ BG Bulgaria .....
☒ BR Brazil .....
☒ BY Belarus .....
☒ CA Canada
☒ CH and LI Switzerland and Liechtenstein
☒ CN China .....
☒ CR Costa Rica .....
☒ CU Cuba .....
☒ CZ Czech Republic .....
☒ DE Germany .....
☒ DK Denmark .....
☒ DM Dominica
☒ EE Estonia .....
☒ ES Spain .....
☒ FI Finland .....
☒ GB United Kingdom
☒ GD Grenada
☒ GE Georgia .....
☒ GH Ghana .....
☒ GM Gambia
☒ HR Croatia .....
☒ HU Hungary .....
☒ ID Indonesia
☒ IL Israel .....
☒ IN India .....
☒ IS Iceland
☒ JP Japan .....
☒ KE Kenya .....
☒ KG Kyrgyzstan .....
☒ KP Democratic People's Republic of Korea .....
☒ KR Republic of Korea .....
☒ KZ Kazakhstan .....
☒ LC Saint Lucia
☒ LK Sri Lanka
☒ LR Liberia
☒ LS Lesotho .....
☒ LT Lithuania
☒ LU Luxembourg
☒ LV Latvia
☒ MA Morocco .....
☒ MD Republic of Moldova .....
☒ MG Madagascar .....
☒ MK The former Yugoslav Republic of Macedonia .....
☒ MN Mongolia
☒ MW Malawi .....
☒ MX Mexico .....
☒ NO Norway
☒ NZ New Zealand .....
☒ PL Poland .....
☒ PT Portugal .....
☒ RO Romania
☒ RU Russian Federation .....
☒ SD Sudan
☒ SE Sweden
☒ SG Singapore
☒ SI Slovenia .....
☒ SK Slovakia .....
☒ SL Sierra Leone .....
☒ TJ Tajikistan .....
☒ TM Turkmenistan .....
☒ TR Turkey .....
☒ TT Trinidad and Tobago .....
☒ TZ United Republic of Tanzania
☒ UA Ukraine .....
☒ UG Uganda .....
☒ US United States of America .....
☒ UZ Uzbekistan .....
☒ VN Viet Nam .....
☒ YU Yugoslavia .....
☒ ZA South Africa .....
☒ ZW Zimbabwe .....

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☐ .....
☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1) 02 February 99	GB 9902146.1	GB		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): Form 23/77 filed

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)* : ISA/

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request	: 3
description (excluding sequence listing part)	: 23
claims	: 5
abstract	: 1
drawings	: 4
sequence listing part of description	:
Total number of sheets	: 36

This international application is accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract:

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Markgraaf Patents Ltd

MARKGRAAF PATENTS LIMITED 02.02.2000

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA/
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

TENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
FP2662		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00282	02/02/2000	02/02/1999
International Patent Classification (IPC) or national classification and IPC E02D3/11		
Applicant NEWCASTLE UNIVERSITY VENTURES et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
30/06/2000	11.05.2001
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Kergueno, J Telephone No. +31 70 340 2369

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00282

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-23 as originally filed

Claims, No.:

1-31 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

   ☐ the entire international application.

   ☒ claims Nos. 31.

because:

   ☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

   ☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 31 are so unclear that no meaningful opinion could be formed (*specify*):
   see separate sheet

   ☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

   ☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

   ☐ the written form has not been furnished or does not comply with the standard.

   ☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

   Novelty (N) Yes: Claims 1-30

	No:	Claims	
Inventive step (IS)	Yes:	Claims	8, 9, 11, 13-16, 22, 24, 27, 30
	No:	Claims	1-7, 10, 12, 17-21, 23, 25, 26, 28, 29
Industrial applicability (IA)	Yes:	Claims	1-30
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

Pursuant to PCT/GL/III 4.10, claims must not, in respect of the technical features of the invention, rely on references to the description or drawings, except where absolutely necessary, which is not the case for claim 30.

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1.1 Document US-A-5074986, considered to represent the relevant state of the art, discloses a method for conditioning a substrate mass (30) wherein the substrate mass is associated with a conducting element (31) and a further conducting element (32), the conducting elements being located within the substrate mass including electrolyte therebetween, wherein a supply system (37) is associated with one of the conducting elements for supply of a conditioning material to be introduced in the substrate mass and wherein a potential difference is applied between the conducting elements which act as respective electrodes and thereby supply conditioning material to the substrate mass.

The subject-matter of claim 1 differs from what is known from the cited document in that an electrokinetic geosynthetic structure comprising geosynthetic material is associated with at least one conducting element. Claim 1, and thus claims 2-16 appended thereon, therefore fulfill the criteria set down in Article 33(2) PCT.

1.2 The same prior art document further discloses a substrate mass conditioning apparatus comprising a conducting element and a further conducting element; a supply system associated with one of the conducting elements for the supply of a conditioning material to be introduced into the substrate mass; and means for applying a potential difference between the conducting elements.

The subject-matter of claim 17 differs from what is known from said prior art in that an electrokinetic geosynthetic structure is associated with at least one conducting element. Consequently claim 17, and therefore claims 18-29 appended thereon also fulfill the criteria in Article 33(2) PCT.

1.3 Method claim 1 and apparatus claim 17 being new, the product being a substrate mass conditioned using the method or the apparatus is also deemed to be new. Attention is however drawn to the fact that in certain regional procedures, a product is not rendered new merely by the fact that it is produced by means of a new process, the use of an apparatus being further considered as a process. Subject to such prevailing considerations, claim 30 is presently deemed to involve an inventive step, Article 33(3) PCT.

2.1 The contribution of claim 1 to the referred-to prior art does not appear to involve an inventive step in view of the teaching in document EP-A-870875 whereby an electrode is incorporated for a similar purpose into a geosynthetic structure, being a drain. It would appear obvious to the skilled person to substitute such an arrangement to the electrode in the prior art for the inherent advantages linked thereof. A same statement applies as regards the corresponding contribution of claim 17 to said prior art.

2.2 Dependent claims 2-7, 10, 12, 18-21, 23, 25, 26, 28, 29 do not appear to introduce features which would support an inventive step since the features in claims 2-7, 18, 19, 21 are known from both above-cited documents; the features in claim 10 are suggested in EP-A-870875, cf. col.1/l.6-26, as well as the features in claims 20,23,25, 26, 28,29; and the features in claim 12 are known from US-A-5074986.

3. The features introduced by anyone of claims 8, 9, 11, 13-16, 22, 24, 27 are not fairly suggested by the entire state of the art, whereby the corresponding respective combinations of features fulfill the criteria set down in Article 33 (3) PCT.

Re Item VII

Certain defects in the international application

The relevant state of the art is not cited in the description, Rule 5.1 (a) ii) PCT and the claims are not provided with reference signs as appropriate, Rule 6.2 (b) PCT.

The demand must be filed directly with the competent International Preliminary Examining Authority if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference: FP2662 WO

International application No.	International filing date *(day/month/year)*	(Earliest) Priority date *(day/month/year)*
PCT/GB00/00282		

Title of invention: METHOD FOR CONDITIONING A SUBSTRATE USING AN EKG

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

UNIVERSITY OF NEWCASTLE
6 KENSINGTON TERRACE
NEWCASTLE UPON TYNE
NE1 7RU

Telephone No.:

Facsimile No.:

Teleprinter No.:

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
GB	GB

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

PUGH, ROBERT COLIN
DEPARTMENT OF CIVIL ENGINEERING
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NEWCASTLE UPON TYNE
NE1 7RU

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
GB	GB

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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State *(that is, country)* of nationality:	State *(that is, country)* of residence:
GB	GB

☐ Further applicants are indicated on a continuation sheet.

International application No.
PCT/GB99/00282

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is [x] agent [ ] common representative

and [x] has been appointed earlier and represents the applicant(s) also for international preliminary examination.

[ ] is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

[ ] is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

MARKGRAAF PATENTS LIMITED
THE CRESCENT
54 BLOSSOM STREET
YORK
YO24 1AP
UNITED KINGDOM

Telephone No.: 01904 610586

Facsimile No.: 01904 610909

Teleprinter No.:

[ ] **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

[x] the international application as originally filed

the description
[ ] as originally filed
[ ] as amended under Article 34

the claims
[ ] as originally filed
[ ] as amended under Article 19 (together with any accompanying statement)
[ ] as amended under Article 34

the drawings
[ ] as originally filed
[ ] as amended under Article 34

2. [ ] The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. [ ] The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: ENGLISH

[ ] which is the language in which the international application was filed.
[ ] which is the language of a translation furnished for the purposes of international search.
[ ] which is the language of publication of the international application.
[ ] which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Sheet No. 3

International application No. PCT/GB99/00282

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	sheets	☐	☐
6. other *(specify)*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ nucleotide and or amino acid sequence listing in computer readable form
6. ☐ other *(specify)*:

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

MARKGRAAF PATENTS LIMITED 30.06.2000

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:
2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):
3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.
4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.
5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

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Demand received from IPEA on:

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

MARKGRAAF PATENTS LIMITED
The Crescent
54 Blossom Street
York YO24 1AP
ROYAUME-UNI

Date of mailing (day/month/year)	
11 October 2000 (11.10.00)	
Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
FP2662	
International application No.	**International filing date** (day/month/year)
PCT/GB00/00282	02 February 2000 (02.02.00)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
THE UNIVERSITY OF NEWCASTLE 6 Kensington Terrace Jesmond Newcastle Upon Tyne NE1 7RU United Kingdom	GB	GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
NEWCASTLE UNIVERSITY VENTURES LIMITED Sun Alliance House 35 Moseley Street Newcastle Upon Tyne NE1 1XX United Kingdom	GB	GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
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[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
Mougamadou ABIDINE

Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

MARKGRAAF PATENTS LIMITED
The Crescent
54 Blossom Street
York YO24 1AP
ROYAUME-UNI

Date of mailing (day/month/year) 29 January 2002 (29.01.02)	
Applicant's or agent's file reference FP2662	**IMPORTANT NOTIFICATION**
International application No. PCT/GB00/00282	**International filing date** (day/month/year) 02 February 2000 (02.02.00)

1. The following indications appeared on record concerning:

[X] the applicant [X] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
SCOTT, Keith University of Newcastle Dept. of Chemical and Process Engineering Merz Court Newcastle upon Tyne NE1 7RU United Kingdom	GB	GB
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

3. Further observations, if necessary:
The person indicated in Box No. 2 has been added as inventor/applicant for the US only.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Elisabeth KÖNIG
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

TENT COOPERATION TRE Y

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing: 10 August 2000 (10.08.00)	
International application No.: PCT/GB00/00282	Applicant's or agent's file reference: FP2662
International filing date: 02 February 2000 (02.02.00)	Priority date: 02 February 1999 (02.02.99)
Applicant: JONES, Colin, John, Francis, Philip	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

30 June 2000 (30.06.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer:

J. Zahra

Telephone No.: (41-22) 338.83.38

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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : E02D 3/11, B09C 1/00

A1

(11) International Publication Number: WO 00/46450

(43) International Publication Date: 10 August 2000 (10.08.00)

(21) International Application Number: PCT/GB00/00282

(22) International Filing Date: 2 February 2000 (02.02.00)

(30) Priority Data:
9902146.1 2 February 1999 (02.02.99) GB

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(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: JONES, Colin, John, Francis, Philip [GB/GB]; Department of Civil Engineering, University of Newcastle, Newcastle Upon Tyne NE1 7RU (GB).

(74) Agent: MARKGRAAF PATENTS LIMITED; The Crescent, 54 Blossom Street, York YO24 1AP (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

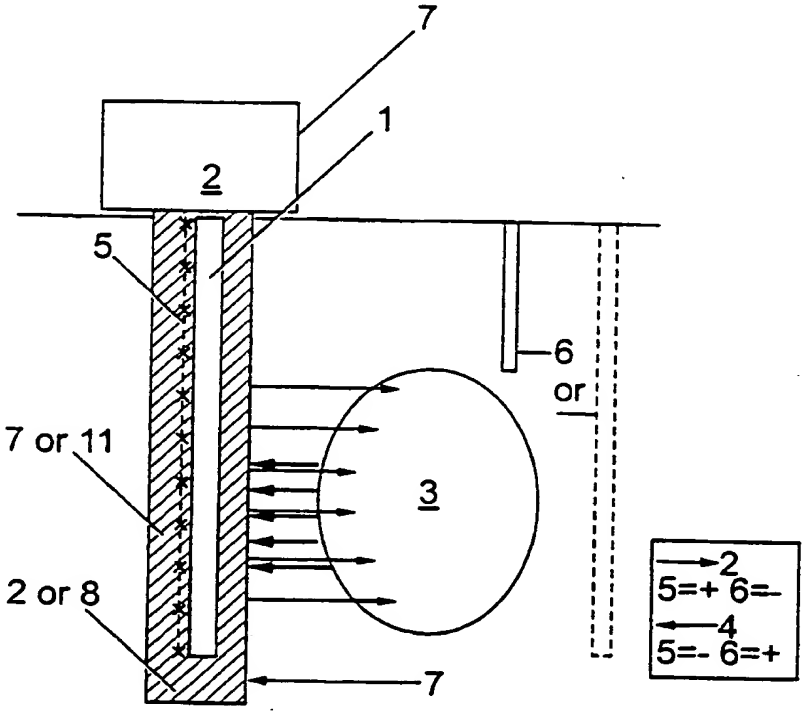
Published

With international search report.

(54) Title: METHOD FOR CONDITIONING SUBSTRATES USING AN ELECTROKINETIC GEOSYNTHETIC STRUCTURE

(57) Abstract

A method for conditioning a substrate mass wherein the substrate mass is associated with an electrokinetic geosynthetic structure comprising geosynthetic material, in turn associated with at least one conducting element, and with at least one further conducting element, the conducting elements being located with the substrate mass including electrolyte therebetween, and wherein a supply system is associated with one of the conducting elements for supply of at least one conditioning material to be introduced into the substrate mass and applying a potential difference between the conducting elements which act as respective electrodes and thereby supply conditioning material to the substrate mass. Apparatus for performing the above method and substrate masses conditioned by the above method and/or apparatus.



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METHOD FOR CONDITIONING SUBSTRATES USING AN ELECTROKINETIC GEOSYNTHETIC STRUCTURE

The present invention relates to a method for conditioning a substrate using an electrokinetic geosynthetic structure, the use of the electrokinetic geosynthetic structure in the method, novel arrangements of electrokinetic geosynthetic structures and conditioned substrates obtained thereby. More specifically the invention relates to a method for conditioning a substrate as defined for moisture or volume control, soil conditioning for agriculture or other purposes, bacterial growth in soils, retrieval and burial of objects in soil and the like, and the corresponding use of the electrokinetic geosynthetic structure, arrangements of electrokinetic geosynthetic structures suited for the purpose of conditioned substrates obtained thereby.

The use of geosynthetic materials for reinforcement or drainage purposes is established practice. The materials used are generally non-metallic and can take any form, the most common being strips, sheets and grids. They can be manufactured by any suitable method, such as knitting, weaving or needle punching, extrusion or the like. Geosynthetics, also known as and sometimes referred to as geotextiles, are typically referred to by their principle function for any particular application and since there are essentially five principle functions there are five types of geosynthetics. These are filtration, separation, membrane, drainage and in plane flow, and reinforcement geosynthetics.

Geosynthetics may also provide any combination of the above functions and the present invention can be used for all of these functions, for example in drainage and reinforcement of substrate material in the construction industry, and thus has numerous industrial applications.

Electrokinetic geosynthetics (hereinafter referred to as EKGs) are electrically conductive geosynthetic or geotextiles. EKGs have an enhanced performance over non-conductive geosynthetics. EKGs, in addition to providing filtration, drainage, separation, acting as a membrane and reinforcement can be enhanced by electrokinetic techniques for the transport of water and chemical species within fine grained low permeability substrates, which are otherwise difficult or impractical to deal with. In addition to conductivity, transivity, absorption, adsorption, wicking, hydrophilic and hydrophobic tendencies may also be incorporated in the geosynthetic.

The ability of electrokinetic phenomena to move water, charged particles and free ions through fine-grained low permeability substrate is established. There are five principle electrokinetic phenomena: streaming potential, migration/sedimentation potential, electroosmosis/electromigration, ion migration and electrophoresis. The first two of these phenomena are concerned with the generation of electrical potential due to the movement of charges and charged particles respectively. The remaining three are concerned with the transport mechanisms developed upon application of a potential difference across a substrate mass.

In practice a potential difference is applied across a substrate mass using EKGs or conventional electrodes. Cations are attracted to the cathode and anions to the anode. The three transport mechanisms are explained below.

In electroosmosis, as the ions migrate they carry their hydration water with them and exert a viscous drag (frictional force) on the water around them. Hence, there is a flow of water to both the anode and the cathode. In order to maintain a charge neutrality however, there are more cations than anions in the pore fluid of a substrate predominantly comprising negatively charged particles. Therefore there is a net flow of water to the cathode. Substrates of

positively charged particles may also be encountered in which case an excess of anions exists for the maintenance of charge neutrality, the net flow of water being to the anode. Electroosmotic flow depends upon the applied voltage gradient and the electroosmotic permeability of the substrate.

The application of a potential difference across a substrate mass causes migration of the free ions and ion complexes, which are present within the pore fluid, to the appropriate electrode. The average mobility of ions in substrates may be of the order of $5 \times 10^{-8} m^2/Vs$, which is an order of magnitude greater than the electroosmotic permeability. Hence, anions can usually overcome the electroosmotic flow and migrate towards the anode; this movement being known as electromigration or ion migration.

When a DC electric field is applied across a particulate suspension, for example a suspension of colloids, clay particles, organics and the like, charged particles in suspension are electrostatically attracted to one of the electrodes and are repelled from the other. Positively charged particles are attracted to the cathode and negatively charged particles are attracted to the anode. Most colloids are negatively charged and are therefore attracted to the anode. This electrophoresis has found applications in the densification of sludges and mine tailings.

EKGs can take the form of single materials, which are electrically conductive, or composite materials, in which at least one element is electrically conductive, such that the EKG can function as an electrode. They can be of the same basic form as commercially available filter, drainage, separator and reinforcement materials, but offer sufficient electrical conduction to allow the application of electrokinetic techniques.

There are a number of materials which can be used to produce electrically conductive geosynthetics, such as carbon fibre materials, conductive composites, polymers and metals in the form of fibres, strips, wires, elements or stitching.

GB 2 301 311 relates to improvements in geosynthetics and introduces EKGs. This prior art document discloses EKG structures including layers of drainage and reinforcement geosynthetics stitched together with conductive fibres. The reinforcement and/or drainage material may also be conductive.

Primarily EKGs are nevertheless associated with removal of contaminants, water and the like from a substrate mass. We have now surprisingly found that by a further adaptation of EKG structures their range of possible applications can be still further extended to considerable advantage.

Accordingly in a first aspect of the invention there is provided a method for conditioning a substrate mass wherein the substrate mass is associated with an electrokinetic geosynthetic structure comprising geosynthetic material, in turn associated with at least one conducting element, and with at least one further conducting element, the conducting elements being located with the substrate mass including electrolyte therebetween, and wherein a supply system is associated with one of the conducting elements for supply of at least one conditioning material to be introduced into the substrate mass and applying a potential difference between the conducting elements which act as respective electrodes and thereby supply conditioning material to the substrate mass.

The geosynthetic may itself be conducting and comprise an electrode or may be located in the vicinity of a conducting element. Reference herein to EKG are to both configurations.

Optionally the method of the invention as hereinbefore defined comprises additionally providing an evacuation system associated with one of the elements for evacuation of at least one conditioning material or of a waste material or by product from the substrate mass, an evacuated conditioning material may be the same as or different to that supplied to the substrate mass. Reference herein to an evacuation system is to any system achieving aided or unaided complete or partial removal of conditioning material or waste material or by-product and the like. Aided removal may use techniques such as eduction and the like.

In each case, the conducting element may be associated with or near a portion of the EKG, and this may be proximal or remote, having regard to the supply system, and is preferably proximal. Without being limited to this theory it is thought that this improves electrical continuity.

Preferably where the method of the invention is for both supply and removal of materials, this is carried out sequentially although it may be simultaneous. In the case of sequential supply and removal the supply and removal systems may be the same or different. Preferably the supply and removal systems comprise hydraulic and electrical continuity with the EKG and respective reservoirs. This is in the case of supply and removal of similarly charged material with reversal of electrode polarity, or materials which are oppositely charged without the need for reversing polarity of electrodes.

Reference herein to substrate is to soil, loam, earth, sod, clay, weak rock and other ground material including mixed ground material and waste material or a mix of ground material and any other material, sewerage, sludge, or other substance or mixture of substances to be retreated, artificial ground material including the aforementioned substrates and other drainage, stabilising and

like materials such as gravel, stones, supply conduits, cables and the like, buried structures and the like.

Reference herein to conditioning is to any treatment which improves the quality of performance of a substrate mass for reason of its intended purpose or for any incidental purpose.

The conditioning material to be supplied and optionally also removed is either fluid or is solid which is capable of being entrained by, suspended in or leached into fluid or otherwise transported as charged particles between the elements under the influence of a potential difference.

Conditioning material may be any liquid or solid material which has a net charge enabling transport by any of the above defined electrokinetic mechanisms and which has a beneficial influence on any desired substrate mass as hereinbefore defined. Particularly envisaged as fluid conditioning material are water and aqueous solutions, salts, nutrients such as nitrogen, phosphorus and trace metals, supplementary carbon source such as acetates, supplementary oxygen sources, terminal electron acceptors such as nitrate, water retention materials such as natural or synthetic hygroscopic materials, thickening materials such as thixotropes, biomass such as specialised bacterial strains, pH regulators, temperature regulators, minerals, reducing agents and oxidants for example for decomposing organics such as petrochemicals and solvents, absorbents such as activated carbon and inorganic porous materials including naturally occurring or synthetic alumino-silicates or zeolites (preferably activated zeolites), metal particles or coated metal particles such as iron or iron filings which may act as catalyst materials, non metallic catalyst materials grout or lime and mixtures thereof.

Conditioning is therefore by means of the EKG structure which comprises a supply system for introducing, dispersing, sorbing, adsorbing, absorbing conditioning materials as hereinbefore defined.

Flow of conditioning material can be controlled in both horizontal and vertical planes. Supply and conditioning may be therefore carried out harnessing or countering the effects of gravity or natural flow in a given substrate mass as desired, for example to enhance the dispersion of conditioning material, to enhance the conditioning by counterflow of conditioning material such as bacteria against the general hydraulic flow within the substrate mass, or to prevent natural flow to an adjacent substrate mass, for example preventing agricultural or industrial run off into aquifers and natural water supplies.

A supply system as hereinbefore defined is any means for supplying conditioning material as hereinbefore defined to an electrode as hereinbefore defined. Preferably a supply system is a permanent supply reservoir in direct hydraulic contact with an electrode, a path or network of paths for hydraulic contact to a permanent or temporary supply reservoir or an aperture for directly or indirectly connecting a temporary reservoir in hydraulic contact with an electrode as hereinbefore defined.

An evacuation system as hereinbefore defined may be any system as hereinbefore defined for a supply system and additionally may comprise aids such as eductors and the like.

A reservoir as hereinbefore defined may be remote from or local to a substrate mass to be conditioned as hereinbefore defined, and interfaced therewith by a supply and optional evacuation system as hereinbefore defined. A reservoir local to a substrate mass may be comprised within the substrate mass, or

adjacent thereto and comprised above or within adjacent substrate, structures, ground, seabed and the like.

A reservoir as hereinbefore defined may be permanent or temporary, natural or artificial. For example a natural reservoir of water may comprise a different substrate mass or different region of the same substrate mass having an available water supply or may be created by preparing a depression in the substrate surface adjacent to one of the electrodes, or building a small soil boundary or embankment to make a pond for collection of water.

An artificial reservoir as hereinbefore defined may be any form of overground or underground permanent or temporary mobile or otherwise container, tank, tanker, cylinder transporter or the like, optionally comprising means to pump the conditioning material to and from the electrode to be supplied or evacuated.

An artificial reservoir is preferably used for supply or removal of materials which it is desired to confine to the mass to be conditioned without wastage or leakage, for example materials which may be potentially toxic, which must be supplied in highly concentrated form and may suffer dilution if not contained, materials which may be rendered inactive if not contained, materials which are not natural to the locus and the like.

A temporary artificial reservoir may be connected to a supply system as hereinbefore defined. A temporary reservoir is preferably a reservoir which also serves as a container for transport of conditioning material and is simply linked up to a supply system as hereinbefore defined at the time of supply, or is an overground reservoir for conditioning material for a substrate mass which it is desired should not be visible when not actively supplying material, or is any reservoir which is to be used for active supply only for a specific

season or period and is redundant in other seasons or periods, or is a reservoir for supply of a material to a number of substrate masses and is simply transferred between locations of different substrate masses as required or the like.

The method of the invention is made possible with the use of geosynthetic material that has at least one conducting element by means of the ability to reverse the polarity of the element to work for supply of any materials in any substrates and optionally additionally for evacuation. It is of particular advantage that this may be achieved without substantial deterioration of the elements which might otherwise have an adverse effect in the conditioning of the substrate mass associated therewith.

One or more other electrodes may optionally be conventional metallic non EKG electrodes, having the advantage of cost reduction in particular where a number of other electrodes are required to condition a large substrate mass area.

Conditioning envisaged according to the present invention may therefore include, but is not limited to, volume regulation of substrate mass, for example according to seasonal or regional moisture variation (drought or flooding) or indeed the localisation, or stabilising or moisture control thereof, for use in construction, foundation laying, road laying, pH regulation, nutrient introduction, environmental clean up, bioremediation, removal of organic or inorganic pollutants, retrieval or burying of subterranean or submarine structures and the like.

Conditioning may be performed for a finite period on a given substrate mass to provide a useable or disposable end product or may be performed

periodially on a given substrate mass to regulate the condition thereof throughout the operational lifetime of the substrate mass.

Conditioning may be performed *in situ* or *ex situ*, choice of conditioning location suitably being according to convenience, safety etc. Conditioing may be carried out batchwise or continuously, this being particularly relevant in the case of conditioning for a finite period to provide a useable or disposable product, for example in clean up or the like.

The present invention derives from the finding that a wide variety of substrate masses as hereinbefore defined may be conditioned as hereinbefore defined by addition of conditioning materials as hereinbefore defined and optionally additionally removal of conditioning materials as hereinbefore defined or of other waste or by product materials. This action of supply can moreover be ideally performed with use of EKGs as hereinbefore defined with a number of associated advantages such as simplicity of construction and operation, minimum disruption to the locus or environment of operation, long term effect in usefulness and resilience to degradation. Moreover according to the further embodiment of the method of the present invention it is possible to supply and evacuate conditioning materials which may be the same or oppositely charged without the need for reversing polarity of the electrodes.

In one preferred embodiment the method of the invention is a method for conditioning soil for burial or retrieval of subterraneous and/or submarine structures such as pipe lines, cables, sewerage systems such as septic tanks and the like. The method provides the advantage that the object to be buried may be buried in a stabilised substrate mass such as soil with minimal subsequent subsidence or settlement and differential settlement which may lead to the malfunctioning or damage of the buried structure or disintegration trawling or other damage to the soil allowing floation and retrieval of the buried object.

Similar advantages are apparent for retrieval of buried structures whereby the retrieval may be carried out with minimal damage or disturbance to the object itself or further neighbouring structures or structure components.

In this method at least two conducting elements are located in the substrate mass to be excavated, with the portion to be excavated therebetween. At least one of the conducting elements is associated as part of a geosynthetic material as hereinbefore defined. Another element may also be associated with a geosynthetic, may be a conventional electrode or may comprise the structure to be buried or retrieved, or a part thereof, where this is of conducting material. A fluid supply system is associated with the geosynthetic material, preferably in the form of a reservoir with hydraulic continuity or wicking contact. An electrical potential difference is applied across the two conducting elements, the geosynthetic element associated with the supply system being the anode and the other electrode being the cathode for a suitable period to pump fluid which may be any softening fluid such as water into the substrate mass to cause softening thereof. A subterranean and/or submarine structure may be readily retrieved either by natural displacement by the softened substrate mass allowing it to rise to the surface or by applying buoyancy or attaching a retrieval line. An object to be buried may simply be sunk into the softened substrate mass and positioned. Thereafter the softened substrate mass may be returned to its former state or be formed into an improved state by reversing the potential difference between the electrodes causing the softening fluid to flow towards the geosynthetic material and evacuated via the supply system or reservoir which now serves as an evacuation system or reservoir.

In a further embodiment the method of the invention is for conditioning substrate masses to serve as foundations for buildings, roads, and other structures. In this case the substrate masses typically suffer from seasonal

moisture variation for example in drought/flood regions, regional moisture variation across the mass itself and the like. Conditioning serves to regulate the strength and volume of the substrate mass. Using a similar method to that previously described the method may be carried out for supply or evacuation of water or aqueous fluid according to the prevailing conditions within or throughout the substrate mass. Moisture may be evacuated from one region and supplied to a further region with the substrate mass by use of a system of elements as herein before defined or may be supplied or evacuated from the entire substrate mass in response to destabilising lack of moisture or excess of moisture. This is of particular advantage for example in substrates with a high clay content or having a content of non-cohesive materials which may be adversely destabilised by lack of moisture.

In a further embodiment the method is for conditioning artificial or natural substrate masses serving for activities requiring regulated uniform moisture content and is a method for conditioning by regulation of optimum water content according to the method as described in the first and second embodiments. According to this method of the invention substrate masses in the form of sports or leisure pitches, fields and the like may be maintained at high condition to avoid excessive dehydration leading to fracture of the surface or excessive hydration leading to over saturation. This is of particular advantage in maintaining quality of expensive sports pitches both throughout the season and in the course of play, leisure sites such as activity parks, fairgrounds, outdoor events such as concerts, camp sites and the like, and the latter which may be on inclined or undulating slopes with natural water supplies worsening the existing problems of rainfall, drought and passage of vehicles and humans.

In a further embodiment the method of the invention is for conditioning substrate mass in the form of soil for agricultural purpose. In this case the

method is as hereinbefore defined but the conditioning material supplied is a soil nutrient for example including salts for soil improvement and the material to be evacuated is soil contaminants, by-products or excess water.

In a further embodiment the method of the invention is for conditioning a substrate mass to serve as a decontaminating mass for decontaminating material to be introduced therein or material naturally or accidentally occurring therein, using the methods as defined above. In this case the conditioning material to be introduced is a decontaminant or contaminant absorbant such as bacteria, activated carbon, inorganic porous material such as naturally occurring or synthetic aluminosilicates for example zeolites and the like. Introduction of bacteria in bioremediation may be accompanied by introduction of bacteria nutrient mixtures or "cocktails". Decontamination may be carried out *ex situ* in which case contaminant material and decontaminant may be introduced into a substrate mass using the method of the invention. Optionally material to be evacuated may be by product, waste, contaminant or excess water.

The method of the invention is particularly suited for bioremediation, whereby bacteria are transported through the substrate mass and are present in any given region thereof for a finite period, avoiding more than a transient exposure to inhibitory concentrations of contaminant. This enhances rate of remediation and renders *in situ* bioremediation highly effective and practical as an alternative to *ex situ* treatment.

The method of the invention for decontamination is particularly useful in environmental clean up of industrial sites. Clean up of high concentrations of halogenated organics and the like preferably employs an EKG as hereinbefore defined comprising an iron, iron/carbon or other modified iron composite high

surface area electrode, which has been found to be highly effective in transferring electrons to adsorbed organics.

In a further embodiment the method of the invention is for conditioning substrate masses such as anchored structures or unstable soil structures by enhancing the cohesion thereof. In this the conditioning fluid to be introduced is a cohesion inducing material such as lime, grout and the like or a solid mass thereof which is leached according to the method into the soil together with supply of water as conditioning fluid. The optional conditioning fluid to be evacuated comprises any contaminant, by-products, waste or excess water.

In a further embodiment the method of the invention is for conditioning subterranean structures which are liable to bio fouling. In this case the condition material to be introduced comprises electrolyte which serves to conduct a current between the elements and thereby kill undesirable bacteria which accumulates, for example in land drains and the like, and the conditioning material to be evacuated comprises water and contaminants and products in the form of decomposed natural matter.

In a further aspect of the invention, there is provided an arrangement for conditioning a substrate mass as hereinbefore defined comprising an electrokinetic geosynthetic structure as hereinbefore defined, a further conducting element as hereinbefore defined together with a supply system and optional evacuation system as hereinbefore defined and means for applying a potential difference between the elements.

The EKG in the arrangement of the present invention may be any as described in GB 2 301 311 and may have any configuration of structure as described in co-pending unpublished GB 9828270 the contents of which are incorporated herein by reference.

The EKG may be in the form of a solid body having a central core which may serve as supply system or removal system for one or both conditioning materials and/or may serve as supply or removal reservoirs in the case of the supply and removal conditioning materials being the same.

The conducting element or elements in an EKG structure as hereinbefore defined may be provided by any known conducting material. For example, the conducting element may be pure or composite metallic such as metals or metal powders dispersed in suitable solid carriers (in particular iron or mixtures thereof), or conducting non-metallic, such as inorganic oxides, polymers or composites thereof. Preferred materials include iron, platinum and the like. In an EKG structure as hereinbefore defined the at least one conducting element preferably comprises conducting non-metallic material such as oxides, polymers, carbon and the like, more preferably selected from oxides of metals of groups II and the transition elements of the Periodic Table of the Elements, for example Mg, Ti, Zr, Fe, Ni, Pd, Pt, Cu, Zn, most preferably sub oxides derived from titanium dioxide, commercially available as Ebonex(TM) (Atraverda). Such material is, by definition, less prone to corrosion than metallic material.

Any shape of the conducting element may be provided which creates a conducting EKG structure. For example, the conducting element may be in the form of a filament, fibre, strand, wire, layer of any shape or other solid or hollow form or otherwise, for example, adapted to conform to the structure or environment. Alternatively, conducting material may be dispersed throughout the sheath and/or core as hereinbefore defined to form the at least one conducting element.

Where a plurality of conducting elements is provided, these may be positioned in an arrangement within the EKG structure or within a part of the EKG structure. For example the conducting elements may be randomly, regularly or irregularly spaced. In one preferred embodiment the conducting elements are in the form of one or more lines of spaced elongate members and are preferably parallel.

The EKG structure may comprise a reinforcing element as hereinbefore defined in any advantageous form and orientation to reinforce the EKG as hereinbefore defined. For example, the at least one reinforcing element may be distributed throughout the EKG, in sheet form, or in the form of one or more elongate elements. In one preferred embodiment, the reinforcing element is at least one high strength elongate element running parallel to the longitudinal axis of the EKG structure.

In a further aspect of the invention there is provided the use of the EKG structure as hereinbefore defined as an electrode. In a preferred embodiment the EKG structure as hereinbefore defined is adapted to be used as both a cathode and an anode. This allows reversal of applied potential difference *in situ*.

The geosynthetic may be manufactured by any conventional method and may be rendered electrically conductive, for example by heat bonding, gluing, needle punching, extrusion, extraction, casting, moulding, weaving, knitting or any combination of these methods. The chosen method is dependent on the required properties of the geosynthetic.

Preferably the material forming the geosynthetic is conductive; this may be achieved in a number of ways. For example, in one preferred embodiment the geosynthetic comprises conductive material and preferably acts as the conducting element.

In another preferred embodiment the geosynthetic comprises a non-conductive material with conducting material running through it at least partially on the outer surface of the geosynthetic.

An electric field for use with the EKG, electrode or in the methods of the invention may be uniform, stepped or otherwise profiled with time or throughout the electrode or EKG. Preferably the field is uniform throughout the structure and varies with time, for example is stepped up from an initial threshold field.

The methods may be used with any number of electrodes. Where more than two electrodes are provided, individual electrodes may be connected to electrical supplies and the electrical potential applied across each anode/cathode pair. Such connection is known as mono polar connection. One disadvantage of mono polar connection is the necessity for high current, low voltage supplies that are relatively expensive.

Alternatively and preferably, the outer two electrodes of an array of electrodes may be connected to an electrical supply. In this way the intermediate electrodes act as induced electrodes and the voltage distributes itself between the outer electrode pair. This is known as bi polar connection and simplifies electrical connection as well as requiring a lower current and higher voltage than mono-polar connections. The reduced current requirements will lead to lower current densities, which are desirable for efficient electro osmosis.

EKGs may be used in combination, for example in an array or grid and thereby be used as a plurality of cathodes and/or anodes, or if in contact with each other, in combination as a single cathode and/or anode. Such an array may be, for example, in the form of interwoven EKG structures making up a

matrix or cloth. In another preferred embodiment the EKG structure as hereinbefore defined is in the form of a continuous, elongate tube, tape or rope. Such EKG structures are easy to transport and position within substrates.

In a further aspect of the invention there is provided the use of an EKG in an arrangement or method as hereinbefore defined.

In a further aspect of the invention there is provided a substrate mass as hereinbefore defined conditioned with use of the method for an apparatus as hereinbefore defined. The effects of conditioning may be sustained for the duration of a single conditioning treatment or may be of prolonged effect. The method and arrangement of the invention are particularly suited for use in conditioning substrate masses which are prone to deterioration by exhaustion of conditioning material within the substrate mass due to consumption by the substrate mass itself or due to the effects of prevailing environmental conditions.

The invention is now illustrated in non-limiting manner with reference to the following figures wherein:

Figure 1 is a vertical section through a substrate mass located between an EKG associated with supply and evacuation reservoirs, and an electrode;

Figure 2 is a horizontal section through a substrate mass containing a plurality of electrodes associated with supply reservoirs and terminating at an EKG with evacuation reservoir;

Figure 3 is a vertical section through an EKG "geobag" containing substrate mass and associated with a supply reservoir at its core and evacuation reservoirs at its perimeter;

Figure 4 is a vertical section of an alternative arrangement to Figure 3;

Figure 5 is a vertical section through an EKG containing conditioning material and located within a substrate mass surrounded by one or more electrodes.

Figure 6 is a view of a wick drain form EKG containing substrate mass and associated with supply reservoirs along its length and evacuation reservoirs at its ends;

Figure 7 is a vertical section through a submarine trench, associated with electrodes for cable laying.

In Figure 1 the EKG structure is shown *in situ* acting as a cathode (5). Anode (6) may be another EKG or a conventional metal electrode. In a preferred configuration, electrode (6) and (5) may be reversed in polarity to serve as cathode and anode respectively, and in this case they are of approximately equivalent length. EKG structure (1) has been inserted into an excavation that serves as a natural supply reservoir (7) and is filled with decontaminant conditioning material (2) such as adsorbent or oxidant or the like. Alternatively the excavation is filled with an electrolyte (8) such as bentonite and serves as a supply system (11) in hydraulic contact with a temporary supply reservoir (7) of conditioning material (2). Conditioning material (2) flows or is transported towards the substrate mass (3) contacting the contaminant resulting in mobilisation or breaking down and mobilisation thereof. Once the contaminant has been fully mobilised, polarity of electrodes is reversed whereby contaminant is evacuated by reservoir (7) or (11) acting as evacuation reservoir (batch wise process).

Figure 2 shows the concentration of contaminant towards EKG structure (1) by use of a plurality of electrodes (6) and impervious membrane (10) which converge towards the EKG structure (6) in the form of an EKG gate.

Electrodes (6) are associated with supply reservoirs (11) for example comprised in impervious membrane (10) via supply system (11) and dispense conditioning material (2) in counter flow to the natural flow of contaminant (4), facilitating mobility and evacuation thereof via the EKG (1) to an evacuation reservoir (7) (not shown).

Figures 3 and 4 show an EKG geo bag and an EKG geo container, both of which can be used to reduce liquid content much faster than the conventional tube. An electric field between electrodes, one (6) inserted in the opening and one (5) comprised in EKG bag (1), transports conditioning material (2) such as thixotrope into the container or bag from a reservoir (not shown) via supply system (11) and transports material to be evacuated such as water (4) out of the container or geo tube through the porous sheath via an evacuation system (11). The fill (3) may be, for example, silt or clay or substrate.

Figure 5 shows the use of the EKG structure with lime piles or soil nails. A lime pile (12) is a hole in the ground filled with lime. The lime pile is used for slope stabilisation and improvement of soft substrates for foundations.

One of the stabilising mechanisms of lime piles is the reaction of lime and the surrounding substrate. The reaction relies on the migration of the lime from the pile. In most substrates this does not influence more than about a 30 mm annular zone around the pile.

Another stabilising mechanism is the strength of the pile itself. In the short term, the realisation of this strength relies on lateral confinement; in the long term this strength is achieved through crystallisation of the lime in the pile.

The performance of lime piles and soil nails is improved using electro osmosis and the EKG structure of the invention, with subsequent carbonisation in the case of lime piles.

The lime or grout (12) is comprised in a supply reservoir (7) in the conductive EKG structure (1). Surrounding the pile with EKG allows electroosmosis to be introduced therefore potentially inducing the conditioning material in the form of calcium (2) to move further and more rapidly into the substrate mass (3). Polarity may be subsequently reversed for redistribution purposes. The EKG also provides lateral confinement. Thus its use improves the short-term strength of the pile and increases the size of the stabilised zone.

Carbonisation increases the effectiveness of the crystallisation in terms of speed and overall strength. It has a potential to improve the strength of the stabilised zone in addition to the pile.

Figure 6 shows a simple conductive EKG structure (1) in the form of a giant wick drain or sock, adapted to enclose substrate mass (3) contained in the geosynthetic core. The drain or sock is suitably vertically aligned such that substrate mass introduced (4) at an opening progresses vertically downwards and is removed at the other end. The outer surface of the drain or sock serves as cathode (5) and an electrode serving as anode (6) is introduced along the axial length of the drain or sock. Supply reservoir (not shown) enclosing the EKG or associated therewith by a suitable supply means allows introduction of conditioning material (2) through the EKG into the substrate mass allowing decontamination or conditioning in a linear continuous process, with

progression of substrate mass along the axial direction of the EKG. Optional removal of take off or waste along the length of the EKG via evacuation reservoir or evacuation system (not shown) may be carried out. In this embodiment, polarity of electrodes may be reversed subsequent to conditioning, to evacuate decontaminant for example.

Figure 7 shows a trench which may be at the grounds surface or the sea bed for example, along the base of which a cable has been laid and material back filled. An EKG runs along the top of the trench, suitably submerged in the backfill, and serves as a first electrode, a second electrode being part of the cable, associated therewith or provided in a second layer there above. To secure the cable and prevent it floating to the surface the soil is first hardened by operating the upper EKG as anode (6). When it is subsequently desired to achieve the object for inspection, maintenance or the like the polarity may simply be reversed the upper EKG serving as cathode to cause movement of saline water into the back fill, using a suitable reservoir or the sea itself as supply reservoir. This avoids to the object which would result from chemical excavation.

REFERENCE NUMERALS

1. EKG Structure.
2. Conditioning material.
3. Substrate mass
4. Evacuated material.
5. Electrode.
6. Electrode.
7. Supply/Evacuation Reservoir
8. Electrolyte.
9.
10. Impervious Membrane.
11. Supply/Evacuation System
12. Lime pile
13. Trench
14. Cable

CLAIMS

1 A method for conditioning a substrate mass wherein the substrate mass is associated with an electrokinetic geosynthetic structure comprising geosynthetic material, in turn associated with at least one conducting element, and with at least one further conducting element, the conducting elements being located with the substrate mass including electrolyte therebetween, and wherein a supply system is associated with one of the conducting elements for supply of at least one conditioning material to be introduced into the substrate mass and applying a potential difference between the conducting elements which act as respective electrodes and thereby supply conditioning material to the substrate mass.

2 A method for conditioning a substrate mass as claimed in claim 1 wherein an evacuation system associated with one of the elements is provided for removal of at least one conditioning material or a waste material or by-product from the substrate mass.

3 A method for conditioning a substrate mass as claimed in claim 2 wherein the evacuation system is in hydraulic and electrical continuity with the electrokinetic geosynthetic structure and a reservoir.

4 A method for conditioning a substrate mass as claimed in any preceding claim wherein the supply system is in hydraulic and electrical continuity with the electrokinetic geosynthetic structure and a reservoir.

5 A method as claimed in any of the preceding claims comprising additionally reversing the polarity of the conducting elements during the

method, or supplying conditioning material of different charge during the method.

6 A method as claimed in any of the preceding claims wherein the substrate is selected from soil, loam, earth, sod, clay, weak rock, gravel, stones, sewerage, sludge and mixtures thereof.

7 A method as claimed in any of the preceding claims wherein a conditioning material is selected from water, aqueous media or solutions, salts, nutrients, supplementary carbon sources, supplementary oxygen sources, terminal electron acceptors, water retention materials, thickening materials, biomass, pH regulators, temperature regulators, minerals, reducing agents, oxidants, absorbents, metal particles, coated metal particles, non-metallic catalyst materials, grout, lime or mixtures thereof.

8 A method as claimed in any preceding claim wherein a conditioning material is a substrate mass softening material and the method comprises the further step of either burying or retrieving an object in/from the softened substrate mass.

9 A method as claimed in claim 8 wherein the softened substrate mass is returned to its former state after softening by reversing the potential difference between the conducting elements.

10 A method as claimed in any of clams 1-7 wherein the substrate mass comprises a structural foundation, a sports pitch, a leisure site or a field and wherein water is supplied to the substrate mass via the supply system and/or removed from the substrate mass via the evacuation system to thereby control the moisture content of the substrate mass.

11 A method as claimed in any of claims 2-10 wherein the substrate mass is soil, a conditioning material is a soil nutrient and the removed material is a soil contaminant, a by-product, excess water or a mixture thereof.

12 A method as claimed in any of claims 1-7 wherein a conditioning material is a decontaminant or contaminant absorbent.

13 A method as claimed in claim 12 wherein a second conditioning material is a contaminated material.

14 A method as claimed in either of claims 12 or 13 wherein the decontaminant/contaminant absorbent conditioning material comprises a bacteria.

15 A method as claimed in any of claims 1-7 wherein the conditioning material is a cohesion inducing material.

16 A method as claimed in any of claims 1-7 wherein the conditioning material comprises an electrolyte which serves to conduct a current between the elements to thereby kill contaminant bacteria in the substrate mass.

17 Substrate mass conditioning apparatus comprising an electrokinetic geosynthetic structure associated with at least one conducting element; at least one further conducting element; a supply system associated with one of the conducting elements for the supply of at least one conditioning material to be introduced into the substrate mass; and means for applying a potential difference between the conducting elements.

18 Apparatus as claimed in claim 17 comprising an evacuation system associated with one of the conducting elements for removal of at least one

conditioning material or of a waste material or by-product from the substrate mass.

19 Apparatus as claimed in either of claims 17 or 18 wherein the supply system and the optional evacuation system comprise respective reservoir(s) in hydraulic and electrical continuity with the electrokinetic geosynthetic structure.

20 Apparatus as claimed in claim 19 wherein at least one of said reservoirs is comprised within the substrate mass

21 Apparatus as claimed in any of claims 17-20 wherein the supply and/or removal system comprises a pump.

22 Apparatus as claimed in any of claims 17-21 wherein one or more of said at least one further conducting element is a metallic non electrokinetic geosynthetic electrode.

23 Apparatus as claimed in any one of claims 17-22 wherein the electrokinetic geosynthetic structure comprises a solid body having a central core which serves as the supply system and/or reservoir and optionally as the evacuation system and/or reservoir.

24 Apparatus as claimed in any one of claims 17-23 wherein the electrokinetic geosynthetic structure comprises a pure or composite metallic or a conducting non-metallic.

25 Apparatus as claimed in any of claims 17-24 wherein the electrokinetic geosynthetic structure comprises one or more lines of spaced elongate conducting members.

26 Apparatus as claimed in any of claims 17-25 wherein the electrokinetic geosynthetic structure comprises a reinforcing element

27 Apparatus as claimed in claim 26 wherein the electrokinetic geosynthetic structure provides a longitudinal axis and the reinforcing element comprises at least one high strength elongate element running parallel to the longitudinal axis of the electrokinetic geosynthetic structure.

28 Apparatus as claimed in any of claims 17-27 wherein the electrokinetic geosynthetic structure comprises a non-conductive material with conductive material running through it at least partially on a surface of the structure.

29 Apparatus as claimed in any of claims 17-28 wherein the electrokinetic geosynthetic structure is in the form of a continuous elongate tube, tape or rope.

30 A substrate mass conditioned using the method as claimed in any of claims 1-16 and/or a substrate mass conditioned using the apparatus as claimed in any of claims 17-29.

31 Substrate mass conditioning apparatus and/or a method for conditioning substantially as herein before described and/or illustrated with reference to the accompanying description and/or drawings.

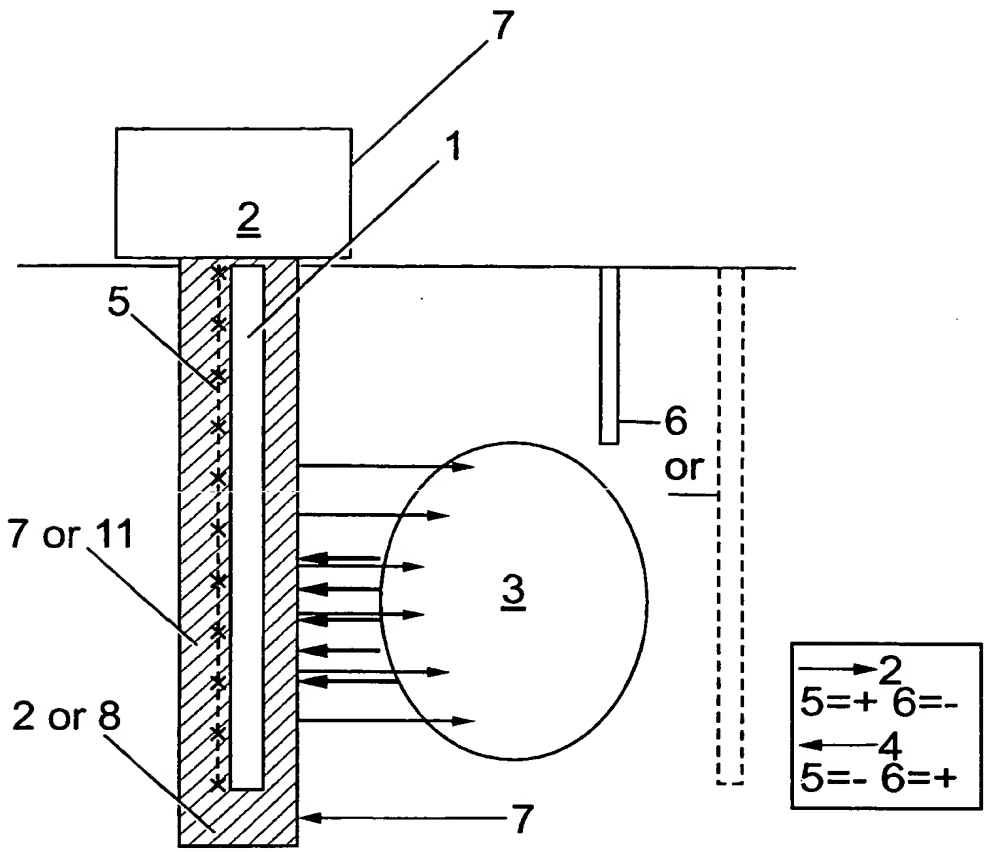

Fig. 1

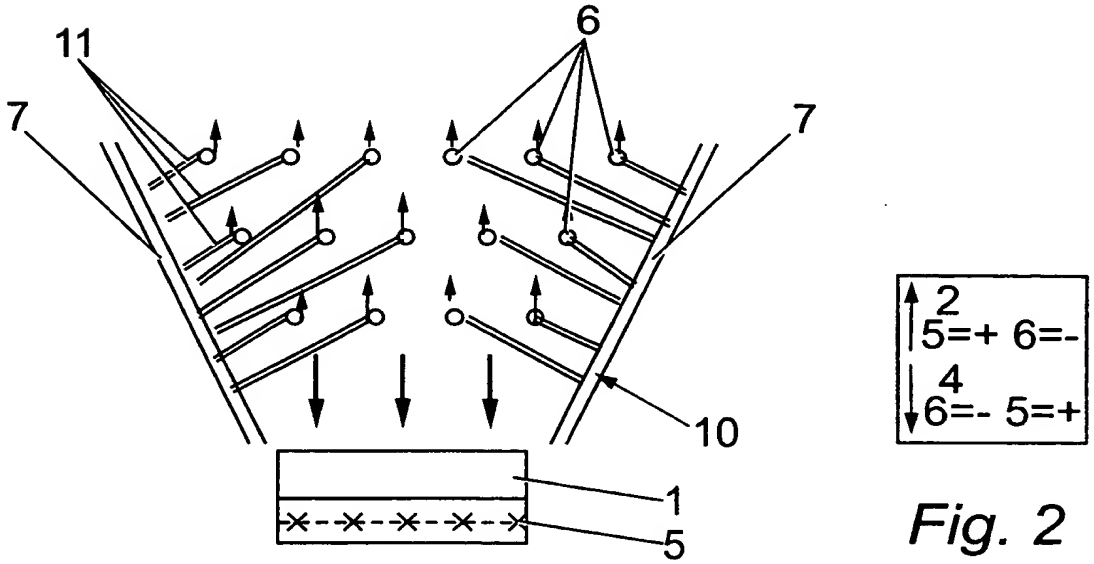

Fig. 2

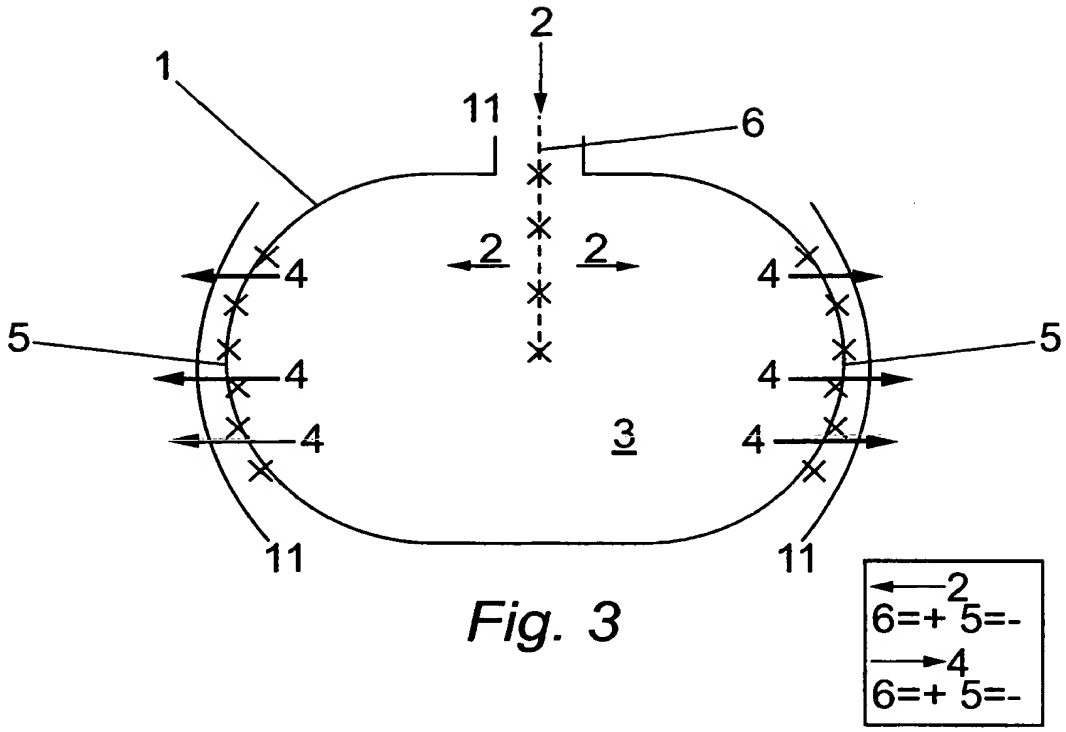

Fig. 3

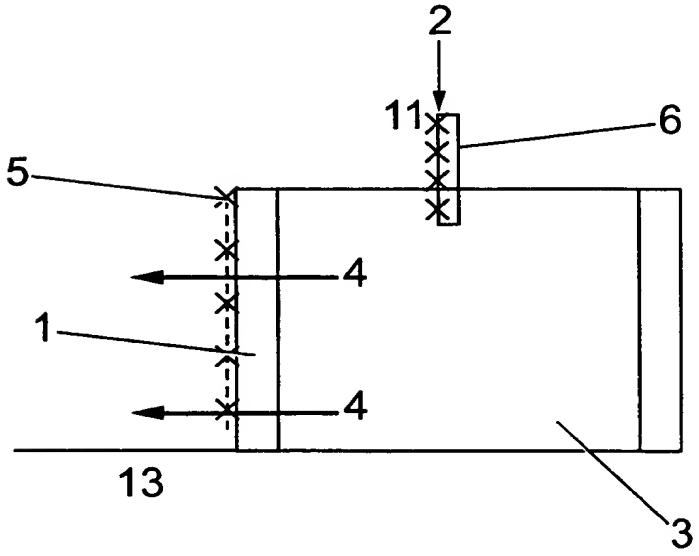

Fig. 4

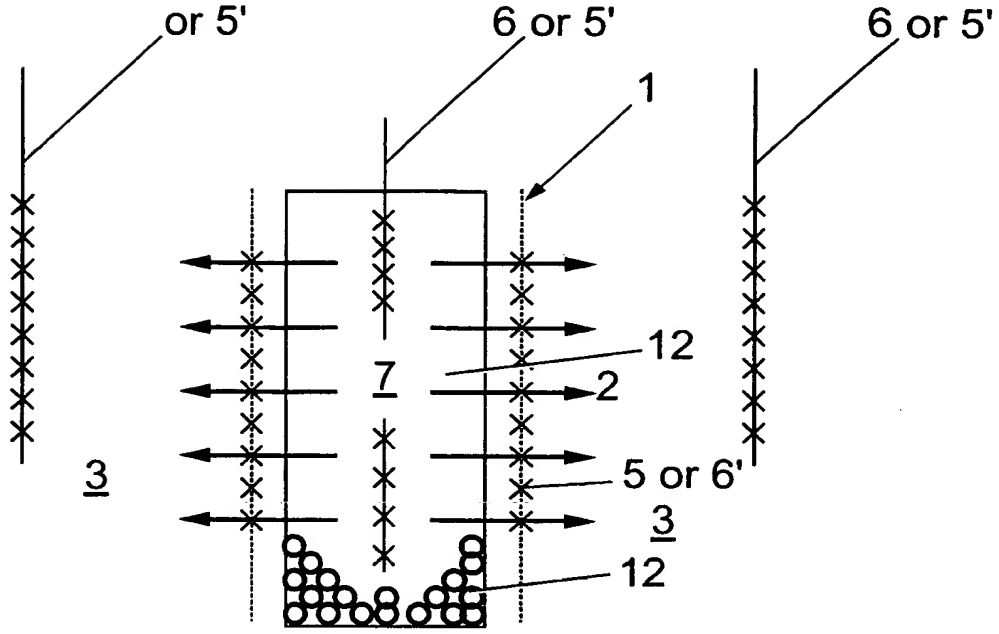

Fig. 5

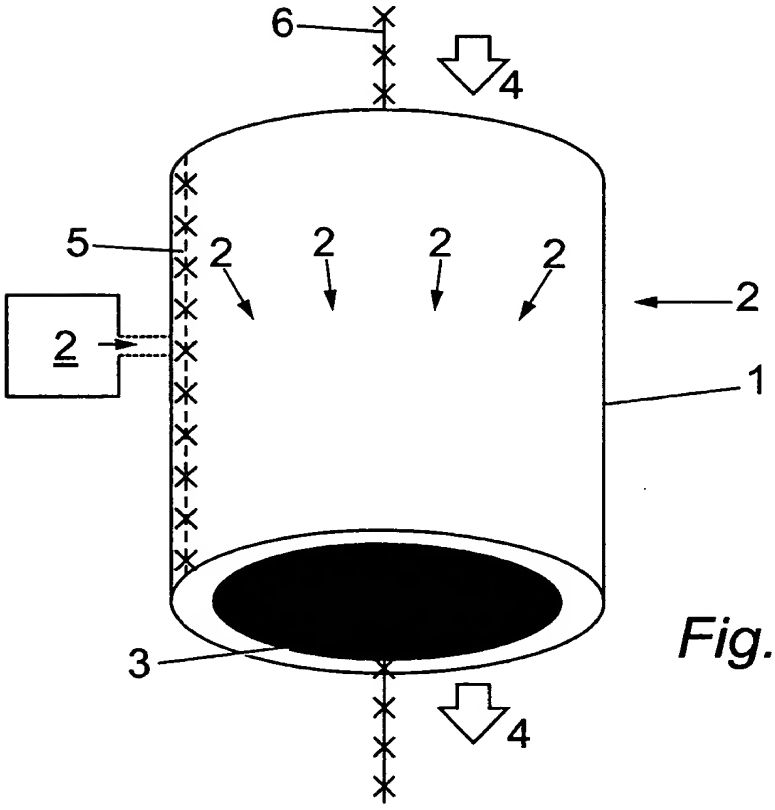

Fig. 6

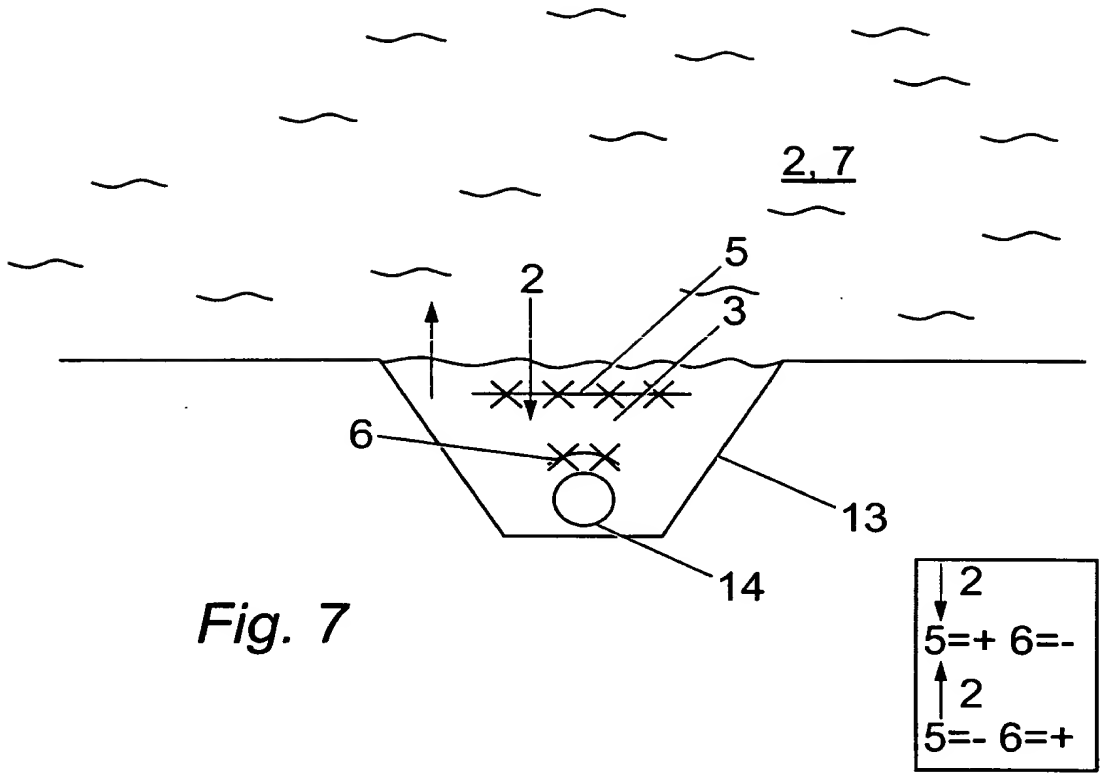

Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00282

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E02D3/11 B09C1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E02D B09C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 074 986 A (PROBSTEIN RONALD F ET AL) 24 December 1991 (1991-12-24) the whole document	1-7,10, 12, 17-21, 23,25, 26,28-30
A	US 5 476 992 A (HO SA V ET AL) 19 December 1995 (1995-12-19) column 4, line 54 -column 20, line 43; figures 1,2	1-7,10, 12,13, 17-21, 23-26,30
A	EP 0 504 551 A (PROCUREMENT & PROJECTS GMBH ;UWA UMWELTANALYTIK GMBH (DE)) 23 September 1992 (1992-09-23) the whole document	1-30

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 2000	18/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Tellefsen, J

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